

**REMARKS**

Please reconsider the present application in view of the above amendments and the following remarks. Applicant thanks the Examiner for carefully considering this application.

**Disposition of Claims**

Claims 1, and 3-13 were pending in the present application. New claims 14-16 have been added by this reply. Therefore, claims 1 and 3-16 are pending after the amendments. Claim 1 is independent. The remaining claims depend, directly or indirectly, from claim 1.

**Claim Amendments**

Independent claim 1 has been amended to clarify the invention recited. Specifically, claim 1 has been amended to include a limitation: “a temperature of the adhesive showing the lowest viscosity is higher than a reaction start temperature.” Support for this amendment can be found, for example, on p. 16, line 20 – p. 17, line 13 and p. 6, lines 3-9. In addition, the amended claim 1 has a new limitation, “to make the connecting terminal of the semiconductor chip contact the connection terminal of the substrate, and heating the adhesive to a second temperature higher than the first temperature in order to cure the adhesive.” Support for this limitation can be found, for example, on p.7, line 4-7. No new matter is introduced by this amendment.

In addition, new claims 14-16 have been added. Support for these new claims, for example, can be found on p. 6, lines 16-22; p. 9, lines 23-24; and p. 23, lines 17-19. No new matter has been introduced by these new claims.

**Rejection(s) under 35 U.S.C § 102 or § 103**

- (A) Claims 1, 3, 6, 7, 10 and 11 were rejected under 35 U.S.C. § 102(e) as being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as being obvious over Takeshita et al. (U.S. Patent No. 6,458,236). Claim 1 has been amended. To the extent that this rejection may still apply to the amended claims, the rejection is respectfully traversed.

The present invention relates to methods for manufacturing electronic devices using two-step bonding processes to avoid air trapping in the adhesive. In the first step a semiconductor chip is temporarily bonded to an adhesive coated on a substrate at a first temperature, followed by permanent bonding at a second temperature that is higher than the first temperature. In addition, in the first temporary bonding step, pressure is applied to an extent that does not cause the opposing connection terminals to be in contact with each other. (paragraph [0014] in the published application No. 2004/0079464).

Air trappings in the adhesives that bond electronic devices severely degrade the performance of the devices. The inventors have found that air trapping can be reduced by lowering viscosity of the adhesive so as to increase the wettability of the adhesive and substrate or chip. In the temporary bonding step of the invention, the semiconductor chip is pressed onto the adhesive, while the viscosity of the adhesive is reduced by maintaining at a first temperature. Therefore, the adhesive is pushed aside from the surface of the connecting terminals during the temporary bonding step.

In the permanent bonding step, the semiconductor chip is pressed such that its connecting terminals contact the connection terminals of the substrate. In the meantime, the adhesive is heated to cure the adhesive.

Specifically, amended claim 1 includes the limitation: “preheating the adhesive to a first temperature no less than the reaction start temperature of the adhesive and below a reaction peak temperature of the adhesive to reduce the viscosity of the adhesive. . . when the semiconductor chip is pressed onto the adhesive in the temporary bonding step, the viscosity of the adhesive is reduced and pressure is applied to the semiconductor chip to an extent that does not cause the opposing connection terminals to be in contact with each other.”

In contrast, Takeshita et al. discloses a method in which the adhesive is semi-cured with a heated head at a first temperature (80-120 °C) prior to the application of an electric part. Then, the electric part is aligned and pressed on to the substrate with the heat head heated to a second temperature (180-250 °C). (Col. 7, lines 26 – 59). Note that the electric part is placed on the adhesive after it has been semi-cured. In contrast, claim 1 requires that “when the semiconductor chip is pressed onto the adhesive in the temporary bonding step, the viscosity of the adhesive is reduced (which is accomplished by heating to a first temperature to reduce the viscosity).”

In addition, in Takeshita et al. the adhesive is stretched and then becomes liquid under pressure by the press head heated to the second temperature. (Col. 7, line 46 – 59). When the adhesive becomes liquid, the semiconductor chip is pressed half way into the thickness of the adhesive layer. Because the adhesive has already been heated to the second temperature when the semiconductor chip is pressed, it is possible that the adhesive may be cured before the contact

terminals are in contact. This might happen if the contacting time of the press head with the semiconductor chip is long, e.g., due to decreased moving speed of the press head.

In the present invention, because the semiconductor chip has been pressed into the adhesive layer (in the temporary bonding step) before the application of the higher temperature, the connection terminals are certain to contact each other before the adhesive is cure in the permanent bonding step.

In view of the above, Takeshita et al. fails to teach or suggest all limitations of the amended claim 1. Therefore, claim 1 is patentable over Takeshita et al. Dependent claims 3, 6, 7, 10, and 11 should also be patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

(B) Claims 1, 3, 6, 7, 10 and 11 were rejected under 35 U.S.C. § 102(b) as being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as being obvious over CN1132931A. Claim 1 has been amended. To the extent that this rejection may still apply to the amended claims, the rejection is respectfully traversed.

CN1132931A discloses a method in which the semiconductor chip is pressed by a heated press head that is heated to a first temperature, after alignment of the semiconductor on the substrate. (p. 5, line 27 – p. 6, line 3 of CN1132931A). As such, the adhesive is not heated to a first temperature when the semiconductor is pressed into the adhesive layer. In addition, the press head (not the adhesive) is heated to the first temperature in this method. This is in contrast to “preheating the adhesive to a first temperature . . . to reduce the viscosity of the adhesive” as required by the

amended claim 1. With the approach of CN1132931A, voids can develop as in prior art methods described in the present application.

In view of the above, CN1132931A does not teach or suggest all limitations of the amended claim 1. Therefore, claim 1 is patentable over CN1132931A. Dependent claims 3, 6, 7, 10, and 11 should also be patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

(C) Claims 4, 5, 8 and 9 were rejected under 35 U.S.C. § 103(a) as being obvious over Takeshita et al. in view of JP 2-226738 and JP 11-330162. Claims 4, 5, 8, and 9 depend from claim 1. Claim 1 has been amended. To the extent that this rejection may still apply to the amended claims, the rejection is respectfully traversed.

As noted above, Takeshita fails to teach or suggest all limitations of the amended claim 1. The Examiner relies on JP 2-226738 for teaching the use of processing tables and JP 11-330162 for teaching heating from the substrate side. These two references do not teach that which is missing in Takeshita et al. Therefore, a combination of Takeshita et al., JP 2-226738 and JP 11-330162 cannot teach or suggest all limitations of the amended claim 1. Therefore, amended claim 1 is patentable over Takeshita et al. in view of JP 2-226738 and JP 11-330162, and dependent claims 4, 5, 8, and 9 should also be patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

(D) Claims 12 and 13 were rejected under 35 U.S.C. § 103(a) as being obvious over Takeshita et al. in view of JP 11-330162. Claims 12 and 13 depend from claim 1.

Claim 1 has been amended. To the extent that this rejection may still apply to the amended claims, the rejection is respectfully traversed.

As noted above, Takeshita fails to teach or suggest all limitations of the amended claim 1. The Examiner relies on JP 11-330162 for teaching heating from the substrate side. JP 11-330162 does not teach that which is missing in Takeshita et al. Therefore, a combination of Takeshita et al. and JP 11-330162 cannot teach or suggest all limitations of the amended claim 1. Therefore, amended claim 1 is patentable over Takeshita et al. in view of JP 11-330162, and dependent claims 12 and 13 should also be patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

(E) Claims 4, 5, 8 and 9 were rejected under 35 U.S.C. § 103(a) as being obvious over CN1132931A in view of JP 2-226738 and JP 11-330162. Claims 4, 5, 8, and 9 depend from claim 1. Claim 1 has been amended. To the extent that this rejection may still apply to the amended claims, the rejection is respectfully traversed.

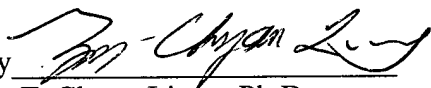
As noted above, CN1132931A fails to teach or suggest all limitations of the amended claim 1. The Examiner relies on JP 2-226738 for teaching the use of processing tables and JP 11-330162 for teaching heating from the substrate side. These two references do not teach that which is missing in CN1132931A. Therefore, a combination of CN1132931A, JP 2-226738 and JP 11-330162 cannot teach or suggest all limitations of the amended claim 1. Therefore, amended claim 1 is patentable over CN1132931A, in view of JP 2-226738 and JP 11-330162, and dependent claims 4, 5, 8, and 9 should also be patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

**Conclusion**

Applicant believes this reply is fully responsive to all outstanding issues and places the present application in condition for allowance. If this belief is incorrect, or other issues arise, the Examiner is encouraged to contact the undersigned or his associates at the telephone number listed below. Please apply any charges not covered, or any credits, to Deposit Account 50-0591 (Reference Number 03310/033001).

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Respectfully submitted,

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